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短　報

First record of *Cavernacmella kuzuuensis* (Suzuki, 1937) (Family Assimineidae) from Ishikawa Prefecture in Hokuriku District, central Japan *

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石川県からホラアナゴマオカチグサ（カワザンショウガイ科）の初産出

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1. Introduction

The well-known *Cavernacmella kuzuuensis* (Suzuki, 1937), a minute species of Assimineidae land snails, is one of only a few cave-dwelling snails inhabiting Japan. This species is reportedly found only in limestone caves from karst areas in which carbonate rocks are widely distributed (Suzuki, 1937; Habe, 1942; Itoh, 1967; Kawana and Matsumoto, 1985; Fukuda and Mitoki, 1995; Kashiwagi, 2012; Kashiwagi et al., 2015), and it inhabits the surface of cave walls kept moist by high humidity within the caves.

Cavernacmella kuzuuensis has been designated as "Critically Endangered and Endangered (CR+EN)" by the Ministry of the Environment in Japan (Ministry of the Environment, 2019). In addition, among the 47 local governments in Japan, 17 have categorized this species as either "Critically Endangered and Endangered (CR+EN)," "Endangered (EN)," "Vulnerable (VU)," "Near Threatened (NT)," or "Data Deficient (DD)." Due to the habitat requirements of troglobites as an obligate cave-dwelling species, *C. kuzuuensis* is extremely sensitive to environmental changes within and outside caves. Therefore, to effectively conserve the species and its habitat, it is necessary to characterize the status of its present population and its distribution throughout each karst region and evaluate the condition of its critical habitat and that of the surrounding lands.

In the Hokuriku District of central Japan, *C. kuzuuensis* occurs in the Shirouma-do Cave in Fukui Prefecture (Itoh, 1967) and in the Saru-ana Cave in Toyama Prefecture (Kashiwagi, 2012). However, no information of its occurrence has been obtained in Ishikawa Prefecture although the Togatani Cave in Ishikawa Prefecture has been known at least 30 years and has been utilized by the Hakusan-roku Children's Natural Center for teaching nature exploration to elementary school students since 2000. Nevertheless, this cave was only recently recognized by the Hakusan Tedorigawa Geopark Promotion Council as an important geosite in the Hakusan Tedorigawa Geopark.

Sakamoto (2011) recently determined the age of the sediments in the Togatani Cave (based on radiocarbon dating) to discuss relative sea level change in the Tedori River drainage basin, although a map of the cave has not been published. Based on the description of the Togatani Cave by Sakamoto (2011), we expected that *C. kuzuuensis* likely inhabits the cave. Therefore, we surveyed the Togatani Cave for *C. kuzuuensis*; herein, we describe the specimens of *C. kuzuuensis* that we found in the cave and provide SEM photographs of important morphological characteristics. A detailed description of the Togatani Cave and its history from its discovery to latest scientific research have been prepared by the authors.

2. Materials and Methods

The Togatani Cave is located along the left bank of Tedorigawa Dam on the upper Tedori River, Hakusan City, Ishikawa Prefecture in central Japan (Fig. 1). The cave comprises a nearly horizontal passage of up to 80 m in length and a subterranean river flows from the upper end of the cave to near its entrance (Fig. 2). The first author searched for specimens on the cave walls on October 16, 2018.

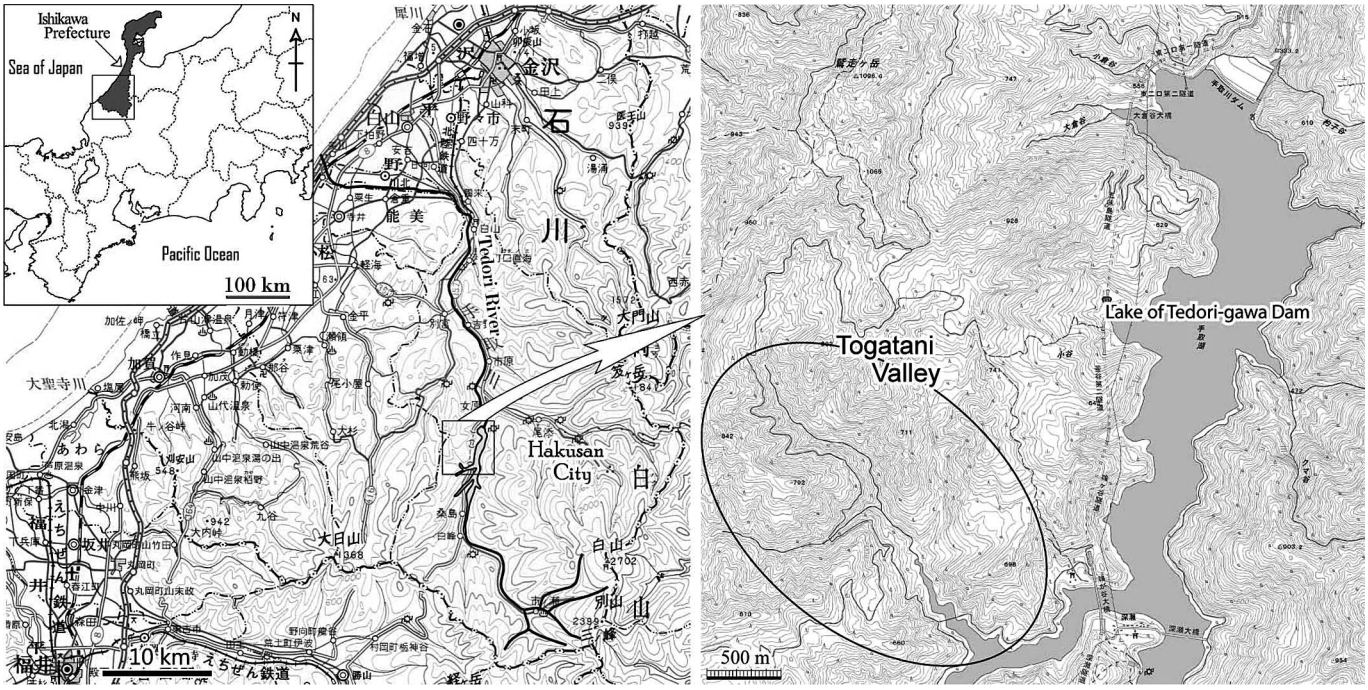

Fig. 1. Location of the Togatani Cave where four empty shells of *Cavernacmella kuzuuensis* (Suzuki) were collected by the first author. The cave is located within the Togatani Valley, a small branch is the Tedori River drainage basin. The precise location has not been shown to protect the cave integrity and the *C. kuzuuensis* population. Base maps are from the Geospatial Information Authority of Japan.

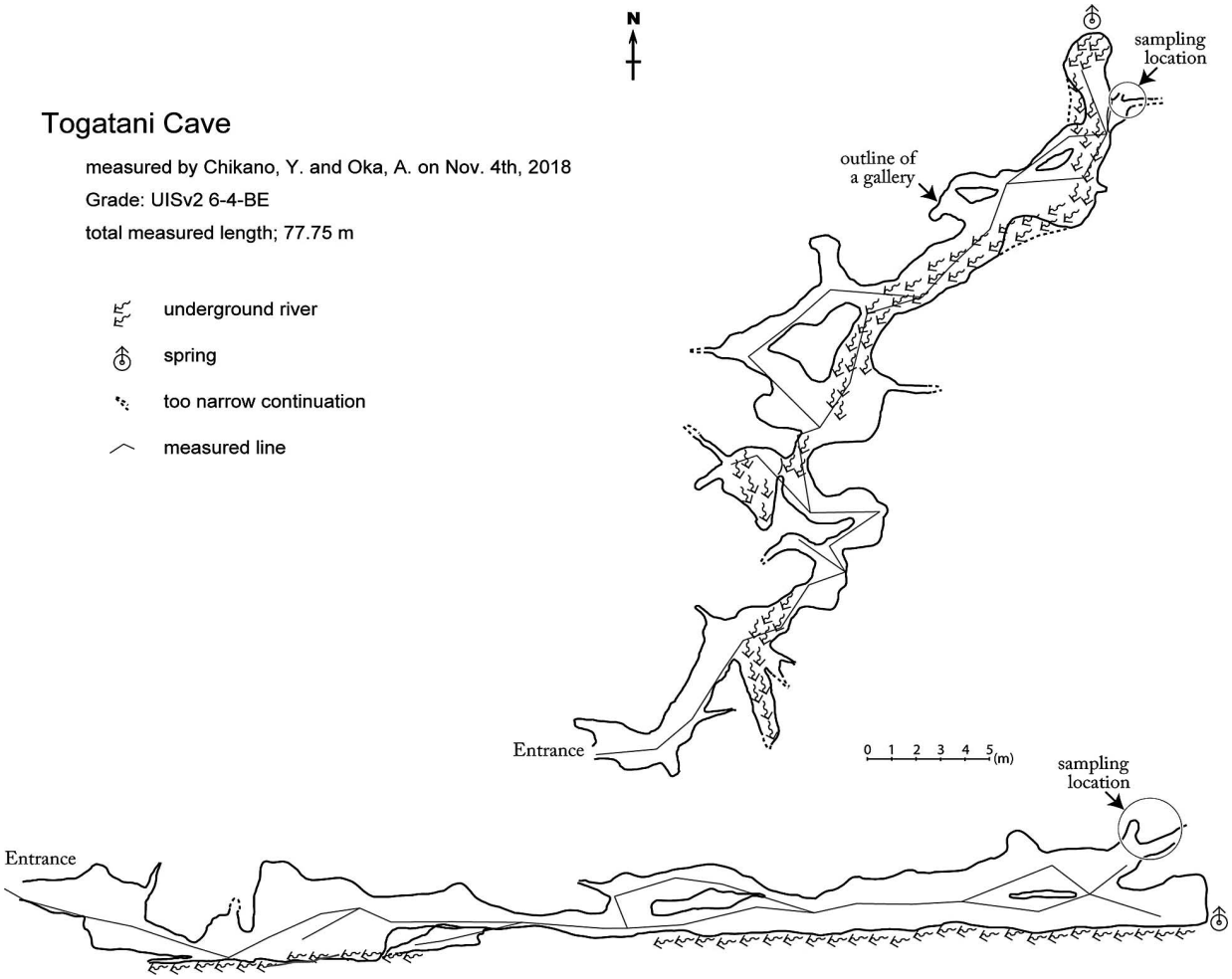

Fig. 2. Simplified plan view and longitudinal profile of the Togatani Cave with the sampling location (circle).

Collected specimens were photographed under a scanning electron micrograph (Hitachi, TM 3030) and measurements were recorded for dimensions of specimens (height and width of shells) using a measurement tool in Adobe Photoshop CS4.

3. Results and Discussion

Four empty shells of *C. kuzuuensis* were collected from the cave wall along an upward-extending fissure at the end of the cave (Fig. 1); the cave was completely dark and very wet, which is characteristic of karst caves. Moreover, a translucent shell was found on the cave wall (Fig. 3), but it could not be collected. Our survey provides the first recorded occurrence of the species from Ishikawa Prefecture and the third recorded occurrence for the species in the Hokuriku District.

The *C. kuzuuensis* shell specimens we extracted from the cave were poorly preserved, white, and opaque (Fig. 4). The environment in which we found the specimens confirms that *C. kuzuuensis* is an obligate troglobite. A few studies have reported that living *C. kuzuuensis* have translucent shells (Habe, 1942; Itoh, 1967). Although we did not collect any living individuals, we were able to photograph a specimen with a translucent shell that was likely living (Fig. 2).

In Ishikawa Prefecture, the distribution of the carbonate rocks is restricted to an area within the strata of Hida metamorphic rocks, which are composed primarily of gneiss and recrystallized limestone (Kobayashi, 1958; Kaseno, 1978). Hida metamorphic rocks mainly occur in the upper reach of the Tedori River drainage basin where the Togatani Cave is located. A survey of underground resources conducted in 1950 showed the presence of a cave of about 8-9 m in length (Hida, 1951). Thus, the area was considered as likely to support other caves. At present, the Togatani Cave is the only limestone cave known in Ishikawa Prefecture that has been precisely mapped. The fact that we found a possible living specimen of *C. kuzuuensis* suggests that conditions within the Togatani Cave are suitable for troglobites. Therefore, the cave should be thoroughly surveyed for rare biota and if any more are found, it should be managed as critical habitat. Furthermore, additional field surveys should be conducted to determine if any more undiscovered limestone caves exist in the area and confirm whether additional populations of *C. kuzuuensis* occur in them.

4. Supplementary descriptions

Family Assimineidae H. Adams and A. Adams, 1856

Cavernacmella kuzuuensis (Suzuki, 1937)

(Common name in Japanese: Horaana-goma-oka-chigusa Habe, 1942)

Morphological characteristics of the illustrated specimens are described as follows: (1) simple ovate-conic outline of shell with relatively rounded apex, (2) tiny shells (height, 1.23-1.54 mm; width, 1.05-1.26 mm), based on four specimens, (3) width and height of each whorl gradually increasing from apex to main body whorl, (4) wrinkle-like sculptures on the surface of protoconch, (5) teleconch whorls convex in outline with faint traces of fine striae, and (6) distinctly constricted sutures between whorls. Collecting site and above-mentioned morphological features support the identification of the specimens from the Togatani Cave as *C. kuzuuensis* (Suzuki).

The shells of the examined specimens were similar in the overall conical outline of shell to some species of the genera *Angustassiminea* and *Assiminea* (Family Assimineidae), although *C. kuzuuensis* is different as it has a more rounded apex and a much smaller and wider than long shell. Furthermore, the habitat of the latter species is salt marsh, not unlit caves. *C. kuzuuensis* also resembles the already- known species of the genera *Akiyoshia* and *Bythinella* (Family Hydrobiidae) in which the shells have a blunt apex, although the former is distinguishable from the latter in that its shell has a broader in outline. Regarding habitat, *C. kuzuuensis* are terrestrial, whereas most species of the genera *Akiyoshia* and *Bythinella* are aquatic.

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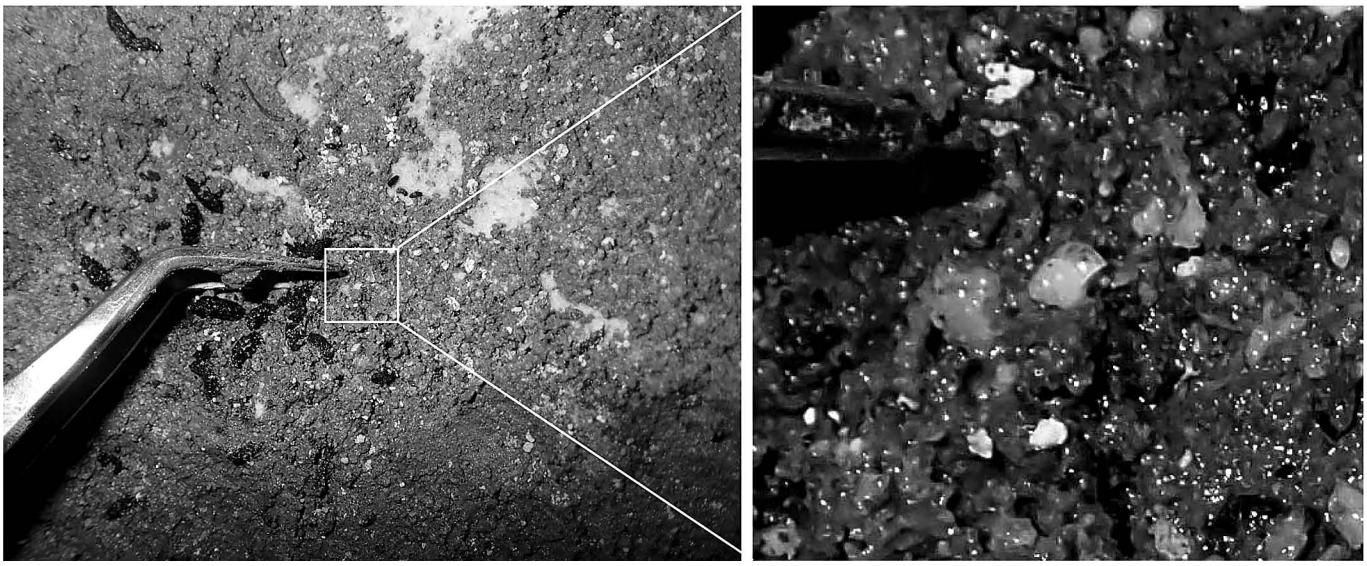

Fig. 3. *Cavernacmella kuzuuensis* (Suzuki) on the wall of the Togatani Cave, central Japan. The right image is a magnification of the white rectangle on the left photograph. A translucent shell is visible on the cave wall in the middle of the right photograph.

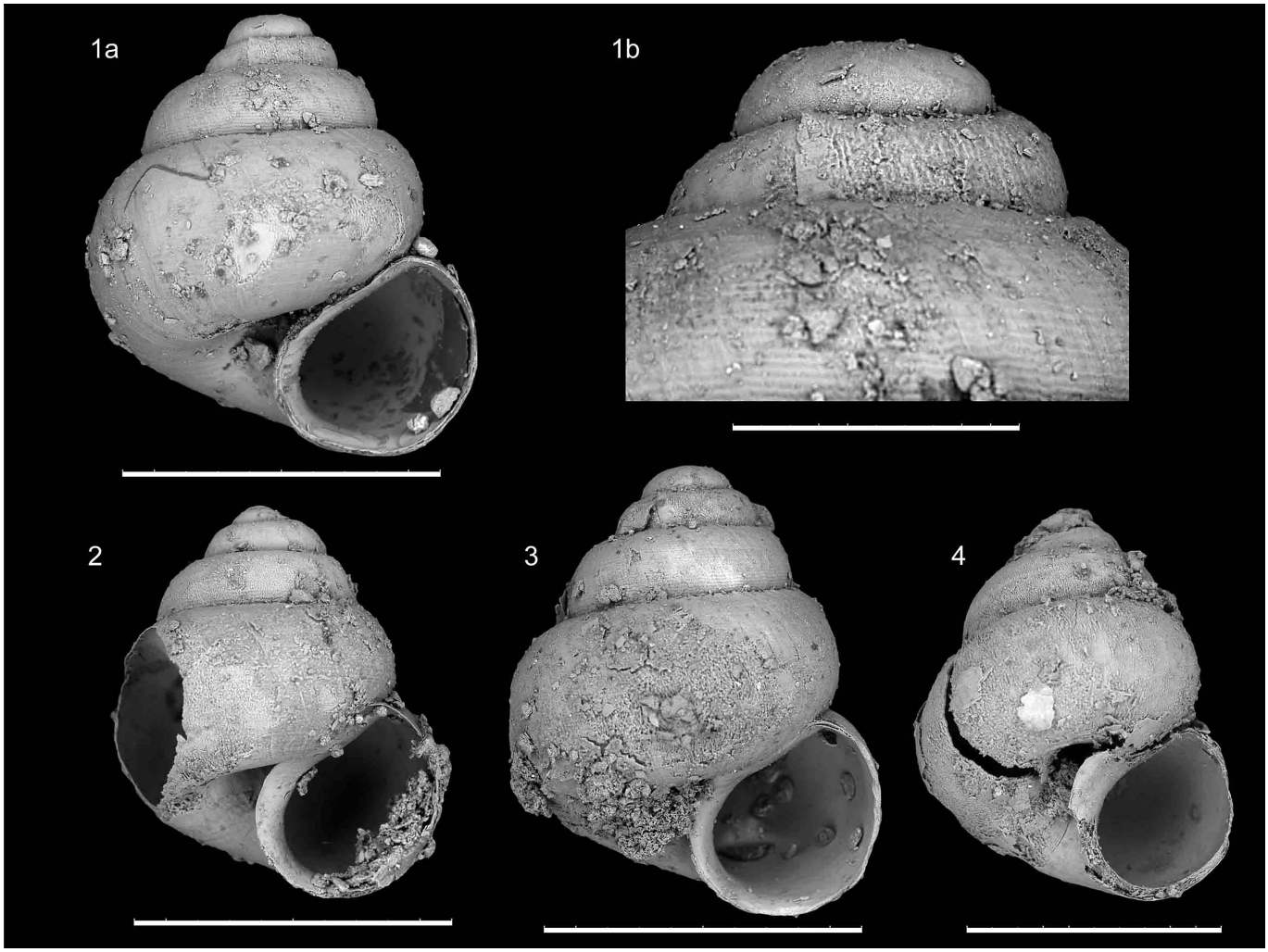

Fig. 4. Scanning electron microphotographs of empty shells of *Cavernacmella kuzuuensis* (Suzuki) collected from the Togatani Cave, central Japan. Scale bars indicate 1 mm except for 1b (300 μm).

Tedorigawa Geopark Promotion Council) and Prof. Aoki, T. (Kanazawa Univ.) for helping us contact with owners of the Togatani Cave, Mr. Yamada, S. (Division of Instrumental Analysis, University of Toyama) for the support of the operation of the scanning electron microscope TM3030 (Hitachi), and Dr. Minato, H. (Shirahama Town, Wakayama Prefecture) for thoughtful comments and suggestions. This research was financially supported by Grant-in-Aids for Scientific Research of Japan Society for the Promotion of Science (16H02235) to Prof. Kano, A. (Univ. Tokyo).

6. References

Fukuda, H. and Mitoki, T., 1995. A revision of the Family Assimineidae (Mollusca: Gastropoda: Neotaenioglossa) stored in the Yamaguchi Museum Part 1: Subfamily Omphalotropidinae. *Bulletin of the Yamaguchi Museum,* (21): 1-20.

Habe, T., 1942. On the recent specimen of *Paludinella* (*Cavernacmella* new subgen.) *kuzuuensis,* with a list of known species of the Japanese cavernicolous molluscs. *Venus,* 12 (1-2): 28-32.

Hida, N., 1951. Research outline on limestone ores around Oguchi Village in Ishikawa Prefecture of central Japan. *In*: Ishikawa Rural Development Office (Ed.) *Research report on underground resources in 1950,* pp. 6-8. Kanazawa. (English translation from the original written in Japanese)

Itoh, R., 1967. On the distribution of *Paludinella* (*Cavernacmella*) *kuzuuensis* Suzuki. *Bulletin of the Akiyoshi-dai Science Museum,* (4): 83-87.

Kaseno, Y., 1978. Geomorphology and geology around Mekkodani Valley in Ishikawa Prefecture with environmental conservations. In: The Natural Conservation Society of Japan (Ed.) *Conservation Report of the Mekkodani water-power plant plan in Hakusan National Park,* Report of Nature Conservation Society of Japan, no. 54: pp. 41-54, Tokyo. (English translation from the original written in Japanese)

Kashiwagi, K., 2012. Land snails from the Kanetsuri area along Kurobe Gorge in the eastern part of Toyama Prefecture, central Japan. : New record of *Cavernacmella kuzuuensis* (Suzuki) of Family Assimineidae in Toyama Prefecture. *Bulletin of the Toyama Science Museum,* (35): 113-117. (in Japanese)

Kashiwagi, K., Yoshida, K., Hirayama, F., Yamaguchi, Y., Matsushita, T., and Kano, A., 2015. *Cavernacmella kuzuuensis* (Suzuki) from the Kiri-ana Cave (limestone cave) in Taiki Town, Mie prefecture, Japan. Mie Natural History Research Group News (Shizen-shi-dayori), (105): 38. (English translation from the original written in Japanese)

Kawana, M. and Matsumoto, M., 1985. New records of land and freshwater mollusca in Saitama Prefecture, Central Japan. *Bulletin of the Saitama Museum of Natural History,* (3): 45-48. (in Japanese)

Kobayashi, H., 1958. The Hida Metamorphic Complex. *In*: Ishikawa, T., Minato, M., Funahashi, M., Hasghimoto, S. and Kobayashi, H. (Eds.) *Jubilee Publication in the Commemoration of Professor Jun Suzuki, M.J.A. Sixtieth Birthday 1956,* pp. 123-140. Sapporo.

Ministry of the Environment (Ed.), 2019. Red List 2019 of Ministry of the Environment, Government of Japan. 129 pp. https://www.env.go.jp/press/files/jp/110615.pdf (in Japanese)

Sakamoto, Y., 2011, Landform development in Tedori river basin and Togatani limestone cave. Abstracts, Japan Geoscience Union Meeting 2011, HQR023-P 15. (In Japanese)

Suzuki, K. 1937. Some fossil terrestrial gastropods from Tuizi, Kuzuu-mati, Totigi Prefecture. *Journal of the Geological Society of Japan,* 44 (524): 438-443.